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Original Article

Circumstances of falls and fall-related injuries among frail elderly under home care in China

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ARTICLE INFO

Article history:
Received 7 January 2015
Received in revised form
24 April 2015
Accepted 29 July 2015
Available online 6 August 2015

Keywords:
Circumstances
Falls
Frail
Elderly
Home care

ABSTRACT

This exploratory study investigated the circumstances of falls and fall-related injuries among frail elderly people under home care. A convenience sample of 500 frail elderly (60–99 years old) from the Wanshoulu and Yuyuantan communities in Beijing's Haidian District during February 2013 and March 2014. Fall circumstances and related injuries were characterized by detailed interviews and questionnaires. The article reports the results of a study that the overall fall incidence was 41.5%, and higher for females than males. Falls mainly occurred in individuals who were over 80 years old (50.0%) and indoors (67.9%). The percentage of subjects who experienced a combined injury after the fall was 56.3%, whereas 19.0% fell causes a fracture. Approximately 35% of the subjects were hospitalized, and 27.6% of the subjects recovered more than 30 days. Results indicate that, falls in the frail elderly caused serious damage, and fall-related circumstances should be a great concern in this population.

1. Introduction

Falling is the main cause of accidental death in the elderly, and is also responsible for much long-term pain, loss of function, and disability. Approximately 18–44% of the elderly (persons over 65 years) in China are reported to fall each year [1–3]. In Beijing, the accidental injury mortality rate is 22.78 per 100,000 people, the fifth-highest (3.79%) cause of death [4]. Fall injuries in the elderly account for 61.84% of the total injuries and are the leading cause for medical treatment. To address this issue, Beijing has launched a three-year program for elderly fall intervention and prevention of damage. However, the incidence of falls in this increasing aging population continues to rise, becoming a major public health concern.

Symptoms of frailty are common in the elderly; they have reduced reserves and resistance to stressors and an increased risk of falls, disability, hospitalization, and institutionalization [5]. Frailty is usually described by four components: fatigue/resistance (can the subject walk up one flight of stairs?), aerobic (can the subject walk more than one block?), illness (more than five kinds), and loss of weight (>5% of body weight lost in the last six months). Previous studies have shown that frailty is

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Peer review under responsibility of Chinese Nursing Association.
http://dx.doi.org/10.1016/j.ijnss.2015.07.002

associated with falls mainly because the loss of muscle mass – which contributes to falling – is a major component of the frailty syndrome [6–9]. Multiple illnesses lead to polypharmacy, another major cause of falls, and impaired balance. Weight loss leads to weakness and exacerbates the muscle loss associated with sarcopenia. Frailty also plays a role in the poor outcomes of falls, including trauma, functional decline, and disability [10–13]. Frail individuals may also have more difficulty coping with the consequences of surgery following a hip fracture than individuals who are not frail [14]. Approximately 30% of hip fracture patients will die within one year [15], and many more will experience significant functional losses; this not only affects the physical and mental health of the elderly, but also results in a great burden of care to families and society. The direct medical cost caused by falls in the United States in 2010 was approximately 3 billion dollars [16]. In Holland, fall-related medical costs reached 675, 400, 000 euros [17]. In China, the annual medical cost of elderly falls is approximately 5 billion [18], resulting in a social resource consumption of about 600–800 billion. After a fall, the elderly experience post-fall anxiety syndrome, which can impair daily life with depression, helplessness, and isolation [19].

Fall risk factors are divided into internal and external factors [20]. Internal factors include age, history of falls, weakness of the lower limbs, and balance. External factors mainly include psychiatric medication and environmental risk factors. New research suggests that risk factors should be classified according to the individual, environment, and behavior, as well as how these three factors interact. Few studies have investigated the specific and detailed environmental factors related to falling of the Chinese frail elderly under home care; the circumstances leading to falls among the frail elderly still need to be elucidated. The appropriate selection of existing interventions is critical to minimize the incidence of falls and their consequences in the frail elderly. However, such knowledge cannot be generalized to older frail individuals unless this subpopulation is included in these studies.

In this study, we investigated the indoor and outdoor falls and fall-related injuries of the frail elderly. We analyzed the circumstances and consequences of the falls, and determined the differences in the features of the falls.

2. Material and methods

2.1. Research ethics

The study protocol was reviewed and approved by the hospital's research ethics committee. Permission to conduct the study was obtained from the Nursing Director of the Hospital. A guarantee of confidentiality and anonymity was included in the invitation letter given to each participant.

2.2. Selection of participants

We randomly selected 500 frail elderly residents in the Wanshou Road community and Yuyuantan community in the Haidian District, Beijing. The residents were studied for one year, in which a total of 190 fall occurred. The inclusion criteria were as follows: subjects of age >60 years with frailty diagnosed according to the Fried criteria and a life expectancy >6 months; the ability to walk independently; voluntary participation; the ability to communicate; and no serious diseases of the nervous system.

2.3. Data collection

We used a questionnaire and interviews to collect the data. After the occurrence of a fall, a doctor conducted home visits. The survey tools consisted of a questionnaire and a community elderly fall risk assessment scale. The self-made questionnaire assessed gender, age, marital status, economic life, living conditions, source of care, walking, chronic diseases, medication, daily life ability, specific time of fall, place of fall, reason for fall, nature of fall, site of injury after a fall, processing method, recovery after injury, and injury after care. The questionnaire's reliability and validity were tested, yielding a Cronbach's alpha coefficient of 0.823. The validity of the questionnaire's content was evaluated by experts, all of which agreed that the items were in good agreement with the investigation contents. The Falls Risk for Older People in the Community screening tool developed by the Australian National Institute of Geriatric Research and revised into Chinese by Wang et al. [21] was used for the assessment of elderly falls and had a Cronbach's alpha coefficient of 0.804. The scale consists of 19 specific evaluation items, using A to D four classification. Scores ranged from 0 to 3, with higher scores indicating higher fall risks.

To reduce bias, the questionnaires were reviewed by the same team of investigators visiting the households, and on-site recycling was conducted. Participants were given instructions in how to complete the questionnaires. The survey data were checked for double entries and then compared for consistency.

Subject age was categorized as 65–79 years old or 80 years and older. Activity level was categorized as minimal, moderate, or vigorous. Location was categorized as indoors or outdoors. Activity was categorized as walking, sitting, standing, walking up or down stairs, lavatory visit, sports and recreation, getting out of bed, housekeeping, cycling, or other. Fall injuries were defined by the International Classification of Diseases 10th revision (ICD-10) and categorized as fracture, laceration, or contusion. Activity distributions leading to indoor and outdoor falls were described separately for all falls. Fall-related fractures were defined as fractures with external codes W00-W19 (ICD-10).

2.4. Data analysis

Data were analyzed by Epidata 3.1 software. Differences in categorical variables were assessed using the chi-square test. Continuous variables were assessed using the Mann–Whitney U test. P values < 0.05 were considered to be statistically significant.

3. Results

Among 500 elderly, 190 (38.0%) reported falling at home in the past 12 months. These subjects (those that fell) had an average

Table 1 – Demographic and clinical characteristics of frail elderly who fell in home, China, 2013–2014.

Variable	Total	60~79	80~
	N = 190	N = 95	N = 95
Sex, n (%)			
Male	68 (35.8)	23 (24.2)	45 (47.4)
Female	122 (64.2)	72 (75.8)	50 (52.6)
Number of diseases, mean (SD) range	5.8 (2.07)	5.0 (2.11)	6.3 (2.43)
Number of medications, mean (SD) range	6.9 (3.97)	6.7 (3.61)	7.1 (3.89)
Living, n (%)			
Alone	39 (20.5)	14 (14.7)	25 (26.3)
With others	151 (79.5)	81 (85.3)	70 (73.7)
Activity level, n (%)			
Minimal	27 (14.2)	11 (11.6)	16 (16.8)
Moderate	87 (45.8)	31 (32.6)	56 (58.9)
Vigorous	76 (40.0)	53 (55.8)	23 (24.2)
Caregiver, n (%)			
Spouse	65 (34.2)	36 (37.8)	29 (30.5)
Children or grandchildren	39 (20.5)	17 (17.8)	22 (23.2)
Children's nurse	27 (14.2)	7 (7.4)	20 (21.2)
Nursing staff	23 (12.1)	8 (8.4)	15 (15.5)
Others	36 (18.9)	27 (28.4)	9 (9.5)
Fear of falling	145 (76.3)	67 (70.5)	78 (82.1)

age of 79.5 ± 7.4 years and consisted of 68 (35.8%) men and 122 (64.2%) women. Approximately 20% lived alone. The most common caregiver after the fall was the spouse. Approximately 76% suffered from a fear of falling again. The demographic and clinical characteristics of the subjects who fell are shown in Table 1.

The characteristics of the falls are shown in Table 2. Most (67.9%) of the falls occurred indoors. The subjects who fell indoors were, on average, significantly older than those that fell outdoors. Approximately 42% of the falls occurred in the morning. Tripping and slipping accounted for 95.8% of the extrinsic factors in the falls, with tripping being the most common extrinsic factor (70.5%). Tripping was mainly caused by walking on air or on the ground, whereas slipping resulted from walking on a wet floor or snowy ground. The most common intrinsic cause of falling was a loss in balance (21.1%). The bedroom was most common location of the indoor falls, particularly for women. The most common location of indoor falls for men was in the parlor. The community was the most common location of outdoor falls. The locations of the falls are shown in Fig. 1.

Table 2 – Circumstances surrounding frail elderly falls stratified by age.

	Total	60~79	80~	P value
	N = 190	N = 95	N = 95	
Location, n (%)				0.029
Indoor	129 (67.9)	57 (30.0)	72 (37.9)	
Outdoor	61 (32.1)	38 (20.0)	23 (12.1)	
Time, n (%)				0.018
Morning	80 (42.1)	48 (25.3)	32 (16.9)	
Afternoon	47 (24.8)	16 (8.5)	31 (16.3)	
Night	63 (33.2)	31 (16.3)	32 (16.9)	
Related to extrinsic factors, n (%)				0.352
Tripping	134 (70.5)	71 (37.3)	63 (33.2)	
Slipping	48 (25.3)	21 (11.1)	27 (14.2)	
Related to intrinsic factors, n (%)				0.046
Loss of balance	70 (21.1)	40 (15.8)	30 (36.8)	
Sudden muscle weakness	26 (13.7)	12 (6.3)	14 (7.4)	
Careless	34 (17.9)	14 (7.4)	20 (10.5)	
Vertigo/dizziness	24 (12.7)	8 (1.6)	16 (8.4)	
Others	36 (18.9)	21 (11.1)	15 (7.9)	

The types of injuries resulting from the falls are shown in Table 3. An injury occurred in 108 (56.8%) of the subjects. The incidence of falls was 28.5% among males and 28.1% among females. The most common injury was soft-tissue contusion (25.3%), both after indoor and outdoor falls, whereas fractures were the least common injury (19.0%). All the fractures involved the arms, chest, lumbar, and hip. Brain injury occurred in 2.1% of the falls. The recovery times after the falls are shown in Fig. 2. A total of 105 subjects (55.3%) required medical treatment, of which 67 (35.2%) went to a hospital for examination.

4. Discussion

This cross-sectional study sampled 500 frail elderly for the incidence and characteristics of falls over a one-year period. The fall incidence rate was 41.5%, which is 2–3-fold higher that of normal (non-frail) elderly [6,22–24] in China. The incidence of falls among women was significantly higher than that among men, consistent with previous studies [25,26]. Elderly woman are postmenopausal, so their estrogen levels have declined, leading to osteoporosis and vicarious bone hyperplasia. Moreover, lower limb muscle strength (especially the quadriceps muscle) decreases significantly in the elderly, leading to weakened muscle and joint functions as well as a decline in balance [27].

Among the extrinsic factors, tripping and slipping accounted for 95.8% of frail elderly falls. The most common extrinsic factor was tripping (70.5%), which was mainly caused by walking on air or on the ground. Slipping resulted from walking on a wet floor or snowy ground. These events conveyed the importance of neatness in the indoor environment. In this study, approximately two-thirds of all falls occurred indoors. A higher proportion of indoor falls occurred among subjects who were 80+ years old than among subjects who were 65–79 years old. The bedroom and toilet were the most common places where falls occurred indoors. Notably, about half of the fracture injuries in men and women occurred indoors in the 65–79-year age group. These data suggest that nursing staff should pay attention to the different characteristics of falls between the non-frail and frail elderly, particularly the frail elderly aged 80 years and above, and ensure the safety of indoor environments.

The majority of falls occurred during the morning, possibly because the subjects were most active (washing and exercising) during this time of day. After a fall, the caregiver was found to be the spouse and/or children (73%), thus increasing the burden of family care. The most common intrinsic factor leading to a fall was a loss in balance (21.1%), which may be due to degradations in neuromuscular control. When faced

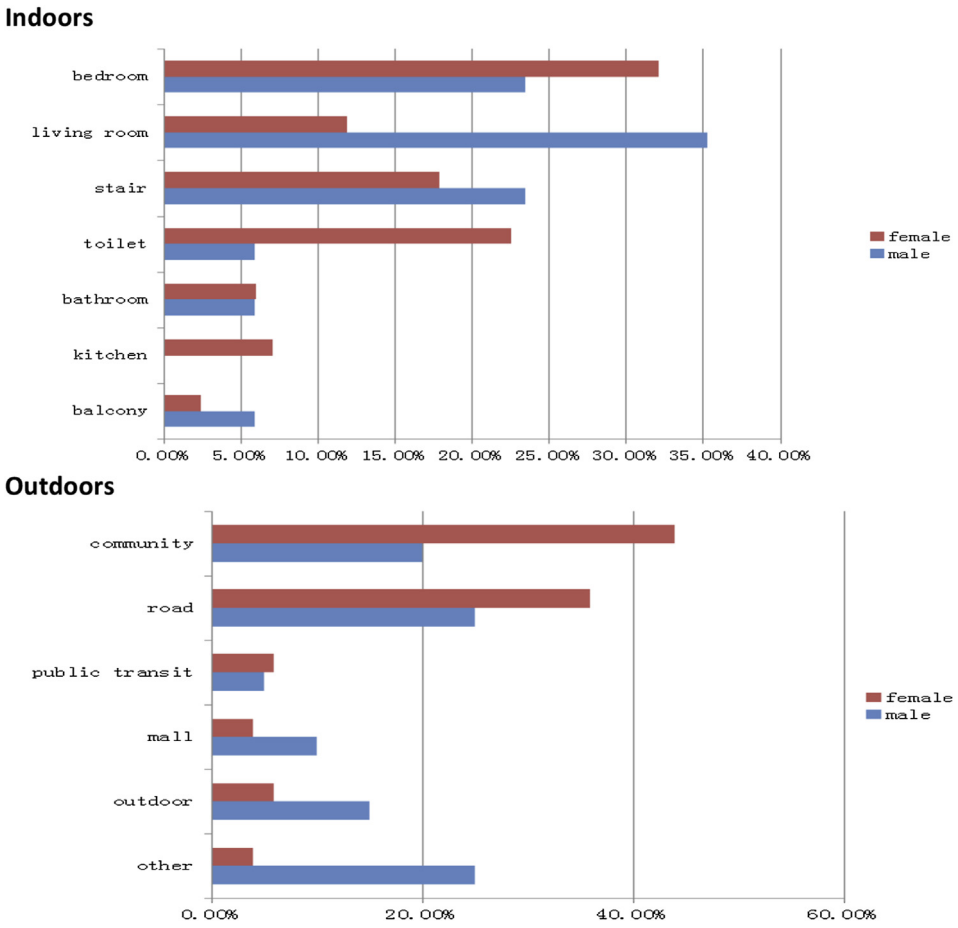

Fig. 1 – Locations of falls, stratified by gender. Data are shown in percentages.

Table 3 – Injuries following a fall stratified by fall places.

	Total	Fall places distribution	
	N = 190	Indoor	Outdoor
Resulted in injury	108 (56.6)	74 (68.5)	34 (31.5)
Type of injury			
Fracture	36 (33.3)	22 (61.1)	14 (38.9)
Lacerations	20 (18.5)	10 (50.0)	10 (50.0)
Contusion	48 (44.4)	35 (72.3)	13 (27.1)
Brain injury	4 (3.7)	4 (100)	0 (0)

with sudden environmental changes, the frail elderly are unable to react rapidly and effectively, which results in instability [28,29]. Therefore, the frail elderly should strengthen their balance and improve their body's stability and response capabilities to reduce the incidence of falls.

Fear of falling is a common psychological consequence that results in decreased physical activity, increased social isolation, damaged social identity, depression, anxiety, and reduced quality of life [30]. Paradoxically, a greater fear of falling leads to a greater likelihood of falling: the fear of falling causes subjects to take negative measures, such as staying

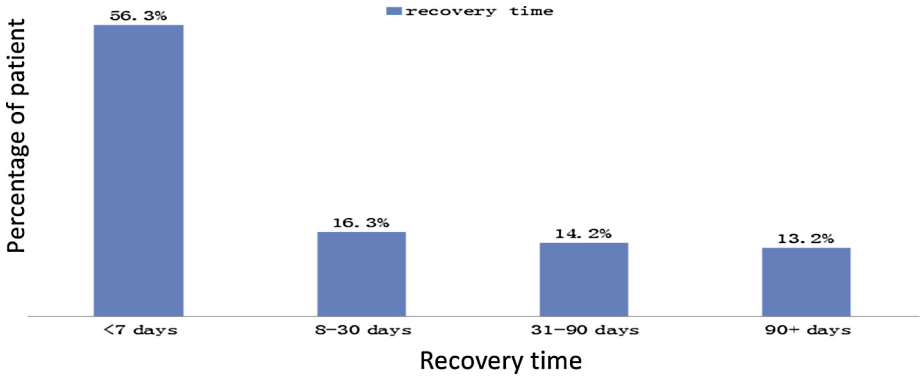

Fig. 2 – Recovery time after the fall.

indoors and being inactive, which decreases body function and balance. In our study, a fear of falling was exhibited by 76.3% of the subjects, higher than the rates in long-term care institutions in the United States (48.2%) [31] and reported by Liu et al. (65.6%) in China [32]. Studies have shown that walking boosts confidence, which can be used as an index of effectiveness in the evaluation of an intervention [33]. The primary objective of the intervention should be to overcome the fear of falling.

The following limitations should be acknowledged when interpreting the results of this study. First, all data were gathered from the elderly, so memory bias may exist. Second, the study was limited to a specific geographic location (Beijing, China), which may have practices different from other provinces, states, and countries.

In conclusion, the incidence of falls in the frail elderly is high. To prevent these falls in the future, detailed circumstances of the falls should be determined in order to develop targeted prevention programs and comprehensive nursing intervention measures. These include home environmental interventions, home facility building, and skills and balance training. These measures should be community- and health education-based in order to improve the quality of life of the frail elderly.

Funding

The Beijing Municipal Science and Technology Commission (D121100004912004).

Conflict of interest statement

The authors declare no conflict of interest.

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